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FOR

**METHOD AND APPARATUS FOR TRANSMISSION AND RETRIEVAL
OF FACSIMILE AND AUDIO MESSAGES OVER A CIRCUIT OR
PACKET SWITCHED NETWORK**

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BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to the field of message receipt/transmission and delivery using computer networks.

5 Specifically, the present invention relates to the subject of facsimile and voice transmission and retrieval over circuit/packet switched voice/data networks.

Description of Related Art

Voice and data communications systems such as the public switched telephone network (PSTN) are currently used to transfer image and text data transmitted by facsimile ("fax") machines in addition to the normally carried voice traffic. These faxed images are usually transmitted through the PSTN and received for printout or storage of the image on a destination fax machine or computer for the use by the recipient. Since the destination machine has typically been a fax, computer, printer or other such large capacity storage and output device, there has not been a need to compress the fax significantly for the destination output device. Furthermore, as the traditional destination has been either a full size print-out, computer monitor or mass storage media, no attempt has been made to facilitate the delivery of fax messages using other methods so as not to require the recipient to be physically close to the device which is coupled to the telephone line in order to receive the fax message.

For example, where user A has a fax machine connected to the PSTN using a telephone line with a number "XXX-YYY-ZZZZ" (where "XXX" represents the area code of the number, "YYY" the prefix of the number, and "ZZZZ" the remainder of the number), in order for 5 user A to view a received fax message, user A must be physically located in the same area as the fax machine.

Similarly, audio messages are stored on fixed destination devices such as answering machines and "voice-mail" systems. To retrieve such audio messages, a recipient would either have to 10 dial into the destination device or physically activate the playback of audio messages through manipulation of the controls of an answering machine.

Thus, the ability to access both voice and fax messages from additional locations which would not require a user to either (1) be physically stationed near the receiving fax machine; or (2) to have to manually call a device to retrieve audio messages; would be desirable.

In addition, as a sender currently has to call or fax directly to the destination phone or fax machine, the sender 20 incurs additional charges imposed by one or more telephone companies handling the call. Depending on the length of the fax or audio message, the telephone company charges can be substantial as calls are billed based on the time connected.

Hence, to be able to provide a sender with multiple phone 25 numbers to which to send a message would be desirable, allowing the sender to choose the number which would closest, and, thus, the least expensive, to dial into.

SUMMARY OF THE INVENTION

To provide for the receipt and transmission of audio and fax information by a first user over a circuit switched network such as the PSTN to a second user over a packet switched network such as the Internet, a communications server is connected both to the circuit switched network and a packet switched network.

The communications server contains resources to receive and process incoming audio and facsimile calls from the circuit switched network into a format suitable for transmission over the packet switched network to the second user's address. In addition, a link is first determined between the second user's address on the circuit switched network and the second user's address on the packet switched network, and then an appropriate route to the second user's address on the packet network is determined. With the system being maintained in a distributed and redundant fashion, reliable receipt and transfer of all messages is ensured.

Thus, this electronic messaging system allows for the transfer of messages such as facsimile and audio messages from the circuit switched network to be collected and routed over the packet switched network.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a system diagram of a network configured pursuant to a preferred embodiment of the present invention containing a message server.

5 **Figure 2** is a block diagram illustrating the message server configured in accordance with the preferred embodiment of the present invention.

Figure 3 is a flow diagram illustrating the operations of the preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention provides a method and apparatus for allowing the receipt and transmission of audio and fax information between a circuit switched network and a packet switched network.

5 For purposes of explanation, specific embodiments are set forth to provide a thorough understanding of the present invention.

However, it will be understood by one skilled in the art, from reading this disclosure, that the invention may be practiced without these details. Further, although the present invention is 10 described through the use of circuit switched and packet switched networks, most, if not all, aspects of the invention apply to all networks in general. Moreover, well-known elements, devices, process steps and the like are not set forth in detail in order to avoid obscuring the present invention.

15 **Figure 1** contains a block diagram illustrating a system configured in accordance with a preferred embodiment of the present invention containing a communications server 150 connected to a circuit switched network 130 and a wide area network (WAN) 180. In the preferred embodiment, circuit switched network 130 is 20 a circuit switched network such as the PSTN while WAN 180 is a packet switched network such as the Internet. It is to be noted that circuit switched network 130 can also be a network such as the generalized switched telephone network (GSTN), which encompasses PSTN networks, cellular telephone networks, and the 25 other networks with which they are in communication.

Communications server 150 is connected to circuit switched network 130 via a switch 140 and to WAN 180 through the use of a router 185. As described in further detail below, in a preferred embodiment, switch 140 and router 185 are interfaced to communications server 150 using two separate hardware interfaces.

5 In an alternate embodiment, switch 140 and router 185 can be interfaced to communications server 150 through the use of one hardware unit.

Connected to circuit switched network 130 is both a telephone unit 110 and a facsimile unit 120. Telephone unit 110 is a standard telephone capable of converting audio signals into electrical signals suitable for transmission over circuit switched network 130. Similarly, facsimile unit 120 is a standard facsimile machine capable of transmitting and receiving facsimile messages over circuit switched network 130. Each of these devices can be connected to circuit switched network 130 using either wired or wireless technology.

Connected to WAN 180 is a database server 195, a system management unit 197, a mail server 160, and a client 190. Each of these systems communicate with each other and with communications server 150 via WAN 180 using such protocols such as simple network management protocol (SNMP) and hyper-text transport protocol (HTTP)--packetized using a protocol such as the transmission control protocol/internet protocol (TCP/IP).

25 In the preferred embodiment, each one of database server 195, system management unit 197, mail server 160, and client 190, are stand-alone computers or workstations containing the hardware and

software resources to enable the operation of the present invention. In alternate embodiments, the functions provided by each one of database server 195, system management unit 197, mail server 160, and client 190, are provided by any number of computer systems.

In the preferred embodiment, mail server 160 is a server providing e-mail receipt and transmission using a protocol such as the simple mail transfer protocol (SMTP) and post office protocol (POP). Moreover, client 190 is configured to be able to communicate over WAN 180 using SMTP or POP in order to retrieve e-mail from mail server 160 or another suitably configured server.

System management unit 197 communicates with communications server 150 to monitor: (1) the processes on communications server 150; (2) the status of the trunk line connected to communications server 150; and (3) the connection between the various servers connected to WAN 180. As described below, if any processes on communications server 150 or connection to the circuit switched network 130 is interrupted, system management unit 197 can allocate resources, or cause the re-routing of a call or message via one or more redundant resources or connections, ensuring that the call or message is routed to the final destination.

Communications server 150 contains user data needed to receive and route incoming messages received from circuit switched network 130. The same information is also stored on database server 195. In the preferred embodiment, communications server 150 stores an inbound address, a set of final destination addresses; and an account status for each user. The inbound

address corresponds to the telephone number assigned to the user. As further discussed below, the inbound address is the number that a message sender dials on telephone unit 110 or facsimile unit 120 to leave a message for the user. The set of final destination address contain one or more e-mail addresses where the user account status information indicates whether the inbound address is either active and or inactive--i.e, whether the user is able to receive messages using the system.

Database server 195 stores a duplicate copy of the inbound address, the set of final destination addresses; and the account status for each user. Database server 195 also stores additional information for each user such as mailing address and billing information which are not used in the operation of the present invention but are note herein for completeness only. Thus, the information that is stored on communications server 150 is a subset of the information that is stored on database server 195, and if communications server 150 were to become inoperable or otherwise unable to handle incoming messages, database server 195 can configure another communications server to accept those calls.

In the preferred embodiment, system management unit 197 is responsible for monitoring the status of communications server 150 and re-assigning the users being handled by communications server 150 if communications server malfunctions or becomes overloaded with incoming calls. In the former case, system management unit 197 would re-assign all users being handled by communications server 150 to another communications server. In the latter case, system mananagment unit 197 would only off-load the only those

incoming calls for which communications server 150 does not have the available resources to process.

Figure 2 is a block diagram of communications server 150 configured in accordance with the preferred embodiment of the present invention, containing a processor 151 coupled to a memory subsystem 153 through the use of a system bus 155. Also coupled to system bus 155 is a network interface 156; a trunk interface 152; and a set of fax/voice processing resources 154. Set of fax/voice processing resources 154 and trunk interface 152 are also coupled to a bus 157.

Bus 157 is a bus that supports time division multiplex access (TDMA) protocols to optimize the flow of real time traffic between set of fax/voice processing resources 154 and trunk interface 152.

Memory subsystem 153 is used to store information and programs needed by communications server 150. The functioning of memory subsystems in computer design are well known to those of ordinary skill in the art and thus will not be further discussed herein.

In the preferred embodiment, trunk interface 152 is a trunk line interface, such as a T-1 or E-1 line, to switch 140 and can handle up to 24 channels of communications. Trunk line signaling is well known to those of ordinary skill in the art of telecommunication and thus will not be further discussed herein except as necessary for describing the invention.

Set of fax/voice processing resources 154 are made up of multiple fax/voice processing cards. Each of these processing cards contain processing units which are capable of receiving and

transmitting facsimiles according to established protocols, and which are capable of digitizing voice or other audio data, also according to established protocols. In the preferred embodiment, there are three fax/voice processing cards in set of fax/voice processing resources 154, each fax/voice processing card containing eight processing units capable of handling a channel from trunk interface 152. Thus, communications server 150 can communicate on twenty-four channels concurrently.

The storage of destination addresses on both circuit switched network 130 and WAN 180 is controlled by a database located either on communications server 150 or on database server 195. Keeping this information separate from communications server 150 allows communications server 150 to be a resource that can be allocated on demand. Hence, a number of communications servers could be used, along with one or more database servers, to allow a fully redundant and scalable system. In addition, system management unit 197 monitors the status and connection of all the communication and database servers.

Figure 3 is a flow diagram illustrating the operations of the preferred embodiment of the present invention when a call originating from a source on the circuit switched network 130. For example, either telephone unit 110 or facsimile unit 120 can initiate the call.

In block 400, an incoming call signal is received by communications server 150 from switch 140. The incoming call signal is initiated by telephone unit 110 or facsimile unit 120 over circuit switched network 130 and is routed to communications

server 150 via switch 140. Communications server 150 detects the incoming call signal using trunk interface 152. Operation would continue with block 402.

Continuing with block 402, trunk line interface unit 152, in
5 addition to receives signals to indicate that there is an incoming call from switch 140, also receives signals indicating the circuit destination address of the incoming call. The destination address is captured by trunk interface 152 and is determined by trunk line signaling using mechanisms such as direct-inward-dial, or dual
10 tone multifrequency (DTMF) tones.

Continuing with block 404, to determine whether or not to process the incoming call, processor 151 searches the list of inbound addresses contained in memory subsystem 153 for the destination address. If processor 151 finds the destination address in the inbound address list, processor 151 will then look up the account status for the user who owns the inbound address to determine if the account of that user is a valid user account. In an alternate embodiment, the validation is performed through the use of a database maintained by a separate entity such as database server 195. If the account is found to be inactive,
20 communications server 151 will play a prepared message indicating that the number to which the incoming message was sent is an invalid account.

In block 406, once the validity of the user account has been
25 established, processor 151 will attempt to allocate one fax/voice processing resource from set of fax/voice processing resources 154 and also determine the availability of other resources required

for the receipt and processing of the incoming call. These other resources include the processing capacity of processor 151, the storage capacity of memory subsystem 153.

If it is determined that the appropriate resources are not available, then the call will be routed to a different communications server that is capable of allocating the necessary resources. The routing of calls is accomplished by trunk line signaling via switch 140 and is managed by system management unit 197.

Also, it should be noted that the call will only come from switch 140 to communications server 150 if there are no problems with the line. Otherwise the call will get routed to a different communications server. In the preferred embodiment, fault detection and correction happens in one of two ways. First, on the telephone network side, switch 140 can be set up to independently route a call to another line if it is determined that one of the lines is bad. Second, if communications server 150 detect that the trunk line coming into trunk interface 152 is down, communications server 150 will notify system management unit 197 to reallocate the users for whom communications server 150 is responsible onto another communications server. Thus, system management unit 197 will transfer the duplicate user information contained in database server 195 into a different communications server.

In block 408, communications server 150 "answers" the incoming call by having trunk interface 152 go "off-hook" on the trunk line.

In block 410, if the fax/voice processing resource of set of fax/voice processing resources 154 which is processing the call determines that the incoming call is a fax transmission, then operation will continue with block 412. Otherwise, operation will 5 continue with block 414. For example, if the call is a fax, a fax protocol is initiated, and the fax is received by one of the fax/voice processing resources of set of fax/voice processing resources 154. If the call is a voice call, the voice is recorded by one of the fax/voice processing resources of set of fax/voice 10 processing resources 154.

In block 412, the fax/voice processing resource of set fax/voice processing resources 154 responsible for processing the incoming call will perform the fax transfer and store the incoming message as a temporary file in memory subsystem 153. In the preferred embodiment, the incoming fax is saved into a file which follows the group 3 facsimile file format. Operation will then continue with block 416.

In block 414, where it is determined that the incoming message is an audio message, the fax/voice processing resource of set of fax/voice processing resources 154 allocated to process the call will initiate an audio recording of the incoming voice message. In the preferred embodiment, the audio message is digitized and stored in memory subsystem 153 as a temporary file in a pulse code modulated format. After the incoming call has 25 been digitized and stored, operation will then continue with block 416.

In block 416, trunk interface 152 will terminate the call. Operation will then continue with block 418.

In block 418, the incoming message, which has been stored as a temporary file in memory subsystem 153, is processed by processor 151. In the preferred embodiment, the temporary file is processed according to the type of the incoming call. If the incoming call was a fax transmission, then the temporary file, which has been stored as a group 3 facsimile file, will be converted into a file which follows the tagged image file format (TIFF), or a format that is suitable for transmission over WAN 180. Optionally, the temporary fax file can also be compressed at this stage. If the incoming call was an audio message, then the temporary file would be compressed using a compression scheme such as the scheme defined in the global system for mobile-communications (GSM) standard. In alternate operations, compressing and other processing of the incoming message is performed as the same time the incoming message is being received and being placed in memory subsystem 153.

In block 420, communications server 150 uses the inbound address to determine the set of final destination addresses, which are destinations on WAN 180 (i.e., the packet switched network), to send the processed incoming message. Communications server 150 then sends an electronic mail (e-mail) with the processed incoming message as an attachment to all the destinations in the set of final destination addresses.

For example, the e-mail containing the attachment is transferred to, and stored in, a server such as mail server 160,

The e-mail is then retrieved by client 190 whenever the user wishes. In an alternate embodiment, client 190 can retrieve the e-mail directly from communications server 150, without the storing operation of mail server 160.

5 While the present invention has been particularly described with reference to the various figures, it should be understood that the figures are for illustration only and should not be taken as limiting the scope of the invention. Many changes and modifications may be made to the invention, by one having ordinary
10 skill in the art, without departing from the spirit and scope of the invention.

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